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The impact of laryngoscopy and tracheal intubation on thyroid gland

Anusha Leah Dias[1]*, **Fraser Gomes**[1]

[1] *Dept. of Anaesthesia, Shri Sathya Sai Medical College and Research Institute, Puducherry, India*

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ABSTRACT

Introduction: Stress, fear, and emotions can induce variations in thyroid and growth factor hormone levels. For many patients, surgery is a significant source of stress, and because thyroid hormone release is influenced by stress, general anaesthesia and endotracheal intubation can raise Thyroid Hormone-blood concentrations. Therefore, this study was carried up to know the impact of laryngoscopy and intubation on TSH and free T4 blood levels in ASA 1 patients.

Materials and Methods: Following approval from the Ethics Committee and informed agreement from the participants, an observational descriptive cross-sectional study was undertaken at the department of anaesthesiology on 30 patients scheduled for elective surgery under general anesthesia. Blood samples were taken in EDTA tubes and tested for Free T4 and TSH levels within 3 hours of collection. A preformatted datasheet was used to document a thorough history, examination results, and laboratory investigations.

Results: Among the study participants out of 30, majority 22(73.3%) were males and remaining 8 (26.7%) were females and the mean age ranged from 17 years to 63 years. Various surgeries included laparoscopic and laparotomy, orthopaedic and urological surgeries. TSH mean levels did not differ among the three sampling sessions. The principal finding in our study was the increase in free T4 level immediately after intubation. Out of the 30 patients, 20 patients showed an increase in free T4 levels immediately after intubation and 8 patients continued to show an increase 20 minutes following intubation.

Conclusion: Results showed increase in free T4 level immediately after intubation with no change in TSH levels. More research is required to conclude the cause for rise in thyroid hormones after anesthesia. These hormonal alterations could shed light on the molecular and cellular effects of anesthetics.

1. Introduction

The thyroid is regarded as a "stress organ." Thyroid and growth hormone levels are known to fluctuate in response to stress, fear, or emotions. However, the intensity and duration of this response during laryngoscopy and intubation are unknown. For many patients, undergoing surgery is a major source of stress and because thyroid Hormone secretion is regulated by stress, general anaesthesia and endotracheal intubation may cause an increase in Thyroid Hormone-blood concentrations. Furthermore, the thyroid may be a target organ for anaesthesia and its metabolites' benefits and side effects. [1,2]

Thyroid hormones control the oxygen consumption of the body's metabolically active tissues. There is a close association between thyroid hormone activity and catecholamine activity. Thyroid hormones increase the number and affinity of adrenoceptors in the heart, making it more susceptible to catecholamine actions. After surgery, total and free T3 concentrations fall and return to normal within a few days. TSH levels drop during the first two hours before returning to preoperative levels. The close relationship between thyroid hormones, catecholamines,

* *Corresponding author*.
E-mail address: anushaldias@gmail.com (A. L. Dias).

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and cortisol may have influenced the changes.[3,4] Hence study was taken up to observe the effect of laryngoscopy and endotracheal intubation upon TSH and free T4 blood levels in ASA 1 patients and to determine the time taken for thyroid hormone levels to return to normal within 20 minutes if there is any significant variation in thyroid hormone levels.

The results of the study may help us to conclude the impact of laryngoscopy and intubation on thyroid gland and may pave way for the future studies on the understanding of metabolic and haemodynamic changes due to variation in thyroid hormones.

2. Materials and Methods

Following approval from the institutional ethical committee and informed consent from the subjects, observational descriptive a cross-sectional study was undertaken in the department of anaesthesia, 30 adult patients with physical status ASA[5] aged between 18 to 70 years undergoing elective surgery under general anaesthesia at Father Muller Medical College Hospital over a period of one and a half years. Pregnant women, patient undergoing Head and neck surgeries, patients who had unanticipated events or complications during surgery (i.e. hypoxemia, resuscitation, or a difficult intubation) and patients with anticipated difficult airway were excluded from the study.

A detailed history, examination findings and laboratory investigations were documented on a preformatted datasheet. Preoperatively, patients were kept nil per oral for 8 hours prior to the surgery. All patients were being premedicated with Tab. Pantaprazole 40mg and Tab. Diazepam 5mg on the night before surgery. On arrival to the operation theatre, 1st blood sample was collected and standard monitoring of the heart rate, non-invasive blood pressure, ECG, peripheral oxygen saturation and ETCO2 was commenced. An intravenous cannula was inserted to administer fluids and medications. Patients were premedicated with fentanyl 2mcg/kg and glycopyrrolate 0.01 mg/kg. Patient was pre oxygenated with 100% oxygen for 3-5 minutes, induced with propofol 2 mg/kg, relaxed with vecuronium 0.1 mg/kg prior to endotracheal intubation. Neuromuscular monitoring was done and fade of train of four stimuli was observed. Laryngoscopy was performed with a Macintosh laryngoscope with an adequate sized blade, and the trachea was intubated with an appropriate-sized cuffed endotracheal tube. After 1 minute of intubation, 2nd blood sample was collected. Patient was maintained on isoflurane, nitrous oxide and oxygen using a closed circuit.3rd blood sample was collected after 20 minutes of intubation.

Blood Samples were collected in EDTA tubes. Free T4 and TSH levels were measured in biochemistry laboratory using automated analyser (Roche Cobas 6000) within 3 hours of collection. The collected data was analysed by calculating frequency, percentage, mean, standard deviation, ANOVA and Chi-square test.

3. Results

As per inclusion criteria, a total of 30 subjects participated in the study. Out of total, majority 22(73.3%) were males and remaining 8(26.7%) were females. The minimum age of the study participants was 18 years and maximum was 63 years with mean and standard deviation of 35 years. Among the total, 19(63.3%) underwent general surgeries such as excision biopsy, lymph node biopsy, laparoscopic and laparotomy. 10(33.3%) underwent Orthopaedic surgeries and 1(3.4%) underwent Urological surgeries.

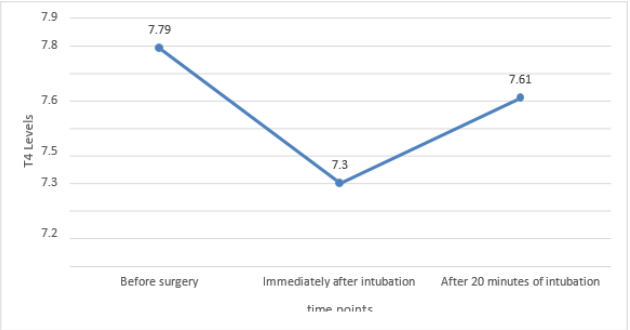

Figure 1: Mean fT4 concentration at different time points, n=30

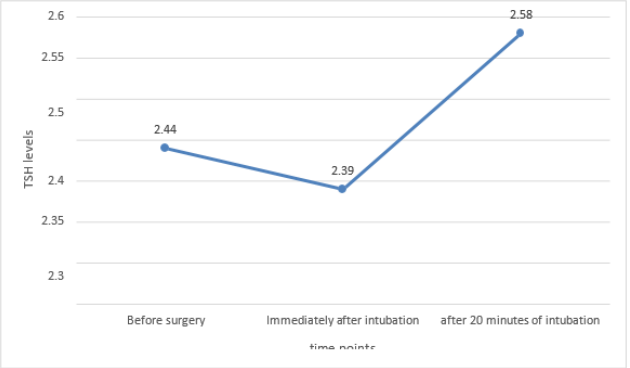

Figure 2: Mean TSH concentrationat different time points, n=30

Figure 1 depicts Free T4 comparison Before surgery, Immediately after intubation and after 20 minutes of intubation. The mean fT4 level before surgery was 7.79 ± 2.11 ug/dl, immediately after intubation was 7.30 ± 2.13 ug/dl and after 20 minutes of intubation 7.61 ± 2.29 ug/dl. The difference in free T4 between these three time points was not statistically significant. (p value =0.171). Table 1 shows the mean difference in free T4 levels before surgery and immediately after intubation was 0.49 ug/dl which was statistically significant (p value =0.036). The mean difference in free T4 levels before surgery and after

Table 1: Multiple comparison of free T4 before surgery,immediately after intubation and after 20 minutes of intubation

Free T4		Mean difference	Test statistics	P value
Before surgery	Immediately after intubation	0.49	2.202	0.036*
	after 20 minutes of intubation	0.18	0.752	0.458
Immediately after intubation	after 20 minutes of intubation	-0.31	-1.006	0.323

*p value <0.05 is consideredstatistically significant

Table 2: Multiple comparison of free T4 Before surgery, immediately after intubation and after 20 minutes of intubation

TSH		Mean difference	Test statistics	P value
Before surgery	Immediately after intubation	0.046	0.335	0.740
	after 20 minutes of intubation	-0.136	-0.640	-0.136
Immediately after intubation	after 20 minutes of intubation	-0.183	-0.962	-0.183

Table 3: Among the patients who had increase

	No of patients who had increase	Minimum difference	Maximum difference
TSH difference (Before surgery- Immediately after intubation)	15	0.12	1.593
TSH difference (Immediately after intubation- 20 mins after intubation)	29	1.01	13.48
fT4 difference (Before surgery - Immediately after intubation)	20	0.09	4.9
fT4 difference (Immediately after intubation- 20 mins after intubation)	8	0.04	4.3

Table 4: Among the patients who had decrease

	No of patients who had decrease	Minimum difference	Maximum difference
TSH difference (Before surgery- Immediately after intubation)	15	0.05	1.44
TSH difference (Immediately after intubation- 20 mins after intubation)	1	1.35	1.35
T4 difference (Before surgery- Immediately after intubation)	10	0.05	1.47
T4 difference (Immediately after intubation- 20 mins after intubation)	22	0.01	4.95

20 minutes of intubation was 0.18 ug/dl which was not statistically significant (p value= 0.458). further, the mean difference in free T4 levels Immediately after intubation and after 20 minutes of intubation was -0.31 which was not statistically significant (p value =0.323)

Figure 2 shows mean TSH concentration at different time points. The mean TSH level before surgery was 2.44 ± 1.15 uIU/Mi, immediately after intubation was 2.39 ± 1.07 uIU/Mi and after 20 minutes of intubation 2.58 ± 1.22 uIU/Mi. The difference in TSH between these three time points was not statistically significant. (p value =0.587). Table 2 shows Multiple comparison of free T4 Before surgery, immediately after intubation and after 20 minutes of intubation. The mean difference in TSH levels Before surgery and immediately after intubation was 0.046 uIU/Mi, before surgery and after 20 minutes of intubation was 0.136 uIU/Mi, immediately after intubation and after 20 minutes of intubation was 0.183 uIU/Mi and the difference was not statistically significant (p value >0.05)

Tables 3 and 4 represents the changes in values of fT4 and TSH in individual patients.

4. Discussion

Thyroid function during general anesthetic surgery is of interest to anesthesiologists for a variety of reasons. The thyroid is thought to be a stress organ that reacts to surgical damage. It is a target organ for anaesthetics and their metabolites' actions and side effects. The stress of direct laryngoscopy and intubation causes rapid fluctuations in blood levels of adrenaline, noradrenaline, cortisol, adrenocorticotrophic hormone, aldosterone, and thyroid hormone.

Thyroid hormones are the primary regulators of cellular metabolism. Because various events linked with anaesthesia might influence thyroid function, understanding the pathophysiology of endocrine function is critical for managing anaesthesia. Furthermore, because several pathways are likely to be involved in the changes in thyroid function tests caused by anesthesia and surgery, combining these nonthyroidal factors may result in different combinations of modifications than either would create alone.

In the study by Halvey et al.,[6] performed on pregnant patients posted for caesarean section, receiving general anesthesia and regional anesthesia. They discovered no significant change in TSH concentrations at the three sample intervals, which included preoperatively, at the time of delivery and 24 hours thereafter. However, fT4 concentrations declined significantly after 24 hours in the general anaesthesia group, but only at the moment of delivery in the regional anaesthesia group. Harland et al. observed an increase in thyroxine secretion soon following surgery and reasoned that thyroxine is released from the liver in halothane anesthesia patients. Brandt et al.[7] made similar conclusion that thyroxin released from the liver was the cause of increased thyroxin levels under enflurane.

In our study, we collected TSH and free T4 blood samples from 30 patients posted for surgeries under general anaesthesia, which included one preoperatively, immediately after intubation and 20 minutes following intubation. The surgeries included general surgery, orthopaedic and urological procedures. There was no change in the mean values of TSH in the three sampling times.

In the study by Oyama et al.,[8] they found no effect of ether or thiopentone anaesthesia in the serial measurements of serum TSH concentration which correlated with our study. Anaesthesia and surgery have been reported to stimulate pituitary hormones such as ACTH , ADH and growth hormone.[9] An exception is that TSH is apparently not changed by anaesthesia or surgery

The principal finding of our study was a statistically significant increase in free T4 levels shortly after intubation (p value =0.036). Out of the 30 patients, 20 patients showed an increase in free T4 levels immediately after intubation and 8 patients continued to show an increase 20 minutes following intubation.

Oyama et al[8,9] found a large quick rise in blood thyroxine levels after halothane anaesthesia, followed by a return to resting level within 2 hours following anaesthesia's end. Chikenji T et al.[10] found in their study that the increases in rT3 and T4 during and soon after surgery are due not to surgical trauma but to inhalational anaesthetics such as enflurane and halothane.

When enflurane was utilized, Börner U et al.[11] discovered an intraoperative rise in free thyroxine (fT4) and total thyroxine (tT4) in plasma to roughly 150% of preanesthesia values. Prior to this, there is no rise in thyroid-stimulating hormone (TSH) secretion. They determined that the rise was not related to a change in the binding proteins' quantitative properties.

An increase in serum T4 and/or fT4 concentrations in patients undergoing anaesthesia and surgery could be due to a variety of factors. The anaesthetic drug may be more responsible for the increase in thyroid hormones than the surgery itself, according to the studies mentioned above.[1,8,10] T4 deiodination inhibition which produces an increase in serum T4 and fT4 concentrations, might cause these hormones to be released from hepatic or other extra thyroidal reserves.[1,12,13]

Despite generally stable plasma TSH levels, serum thyroxine levels increased considerably following intubation. The current investigation demonstrates that TSH does not play a significant effect in serum thyroxine levels during anaesthesia and surgery. In our research, as there was no increase in TSH, but an increase in free T4 levels, it can be concluded that the central feedback mechanism in regulation of thyroid hormones T3,T4 does not have any role.

Interestingly, a number of the studies looked at thyroid function testing in individuals who were undergoing surgery, with diverse results. Based on the contradictory reports of changes in serum T4 and fT4 and TSH concentrations, it's likely that the anaesthetic protocol, surgical method, and patient status all have a role in the changes in these tests, and may each work through various processes.

However, without data from published research on the impact of anaesthetic on thyroid function testing in humans, it may be challenging task to interpret the results of these tests and to determine when samples may be evaluated without the interference of the effects of anaesthetic procedures. As a result, it's critical to understand about the effects of anaesthesia, intubation and surgery on thyroid function tests.

5. Conclusion

The thyroid is regarded to be a "stress organ. Stress, surgery, and anesthesia have an influence on thyroid hormone secretion. Thyroid hormone levels in the blood rise as a result of laryngoscopy and endotracheal intubation. There hasn't been a lot of relevant research on how tracheal intubation affects thyroid hormone levels.

Our findings included an increase in free T4 level immediately after intubation with no change in TSH levels. More research is required to conclude the cause for rise in thyroid hormones after anesthesia. These hormonal changes may shed light on the molecular and cellular effects of anesthetics.

6. Limitations of the study

Our study is not truly representative of the general population because the sample size is inadequate to come to any conclusion. Further clinical studies need to be performed to validate our quantitative data. Stress of surgery can also result in an increase in thyroid hormone levels. It is possible that a more invasive or prolonged surgery would affect thyroid function tests more dramatically or in different ways. The patients in this study were clinically healthy, which is typically not the case in most patients undergoing surgery under general anesthesia. In these cases, the impact of the concomitant illness on thyroid function tests may be more significant than the effects of anesthesia and surgery. Therefore, to more thoroughly evaluate the effect of laryngoscopy and intubation on thyroid function tests, future studies should involve larger population undergoing various surgeries.

7. Source of Funding

None.

8. Conflict of Interest

None.

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Author biography

Anusha Leah Dias, Senior Resident https://orcid.org/0000-0003-1767-4151

Fraser Gomes, Assistant Professor https://orcid.org/0000-0002-2955-3878

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